NOAA Coral Reef Information System (CoRIS) Data Outreach Project 2003

American Samoa and the Hawaiian Islands

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Special thanks to Sea Grant Educators Sara Peck and Darren Okimoto for their help in organizing the community meetings, and to all the participants for taking time to provide valuable insights into the development of the NOAA Coral Reef Information System.

Executive Summary

A series of nine meetings held in American Samoa and Hawaii that were organized by Mark McCaffrey, Science Communications Specialist with the NOAA National Climatic Data Center's Paleoclimatology Branch, were conducted between October 20th and 28th, 2003 with current or potential users of the NOAA Coral Reef Information System (CoRIS). The meetings were designed to provide current and potential users of the CoRIS with an overview of the website and discuss how it can best serve their specific user needs. An additional secondary goal was to identify potential data providers whose metadata could be added to the CoRIS catalogue.

Input from participants in the meetings indicate many current and potential users of CoRIS like the general style and background materials of the website, that in some cases they don't find the information they expect to find through Data Discovery, and that they have high expectations and ideals of how NOAA can in the future meet their information needs relative to coral reefs and their diverse ecosystems. Following are specific ideas that emerged from the community meetings involving the various coral reef constituents on how to improve CoRIS in order to better serve the needs of its users.

- Develop customized interfaces to meet the specific needs of distinct user groups.
- Expand data and especially information resources available through **Data Discovery**, such as including MPA boundaries on maps, coral-related socio-cultural resources and research, coastal development information, and reef monitoring data from non-PhD researchers.
- Add additional resources to **Library** and **About Coral Reefs** such as Alien/Invasive Species and Sea Turtles.
- Provide a "scaffolded" approach to data through place-based or thematic tutorials and case studies, building from simple overviews to complex data analysis.
- Develop non-Internet dependent versions of CoRIS and related NOAA coral resources in CD-ROM and/or DVD formats.
- Network with other Databases and Networks, making them available through Data Discovery.

A number of specific pilot projects were identified for potential follow-up that would provide the opportunity to develop "place-based" or thematic tutorials in an interdisciplinary context, and to expand the scope of data and information accessible through the CoRIS system. These include:

1. Highlighting the terrestrial and marine aspects of coral reef ecosystems in American Samoa.
2. Collaborating with USGS by ingesting USGS metadata into CoRIS.
3. Showcasing reef monitoring efforts and related watershed studies such as at the Limahuli National Botanic Garden on the island of Kaua'i.
4. Focusing on monitoring of Sea Turtles' health and migrations.
5. Emphasizing research in the Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve.
6. Linking to resources at UH and Bishop Museum relating to topics such as Invasive Species.

In summary, members of the coral reef communities who represent current and potential users of CoRIS appreciate its current materials, are somewhat frustrated by the lack of information and confusing interfaces of some of the data discovery tools, and have lofty expectations of NOAA in general and CoRIS in particular to provide them with diverse, timely and easily understood information relating to their areas of interest. Evaluation surveys of the meetings indicate these forums were successful at increasing awareness about CoRIS, and that local island data and/or regional data collections (ideally contextualized and interpreted rather than presented only as raw data) would be extremely helping in communicating coral reef science.

These community meetings owe much of their success to the involvement of Sea Grant and other partners who helped in bringing together a variety of user perspectives. This community-based approach, coupled with formal usability testing, may serve as a model for future outreach actions that will help inform and engage current and potential users "early and often," and result in the development and deployment of more user-friendly and user-centric products and services.

CoRIS Data Outreach Summary Table	Priority	Implement Difficulty	Additional Funding
Customize User Interfaces	Med.	Med.	$
Expand data/metadata			
-NOAA-wide	High	Med.	$
-Non-NOAA	Med.	High	$$
Add Information Resources			
- Alien/Invasive Species	High	Med.	$
-Sea Turtles	Med.	Med.	$
-MPA boundaries	High	Med.	$$
-Searchable Bibliography	Med.	Med.	$
Provide Scaffolded Materials			
-NWHI	High	Med.	$$$
-Limahuli N.B.G.	High	Low	$
-American Samoa	High	Med.	$$
-Kona Coast (NPS)	Med.	Med.	$
Collaborate with USGS/CRTF	Med.	Med.	$
Develop CoRIS DVD	Med.	Med.	$$

Table 1

Report Findings

The National Research Council in their recent publication "Exploration of the Seas: Voyage Into the Unknown" notes that "coral reefs, covering only 0.2% of the ocean area, provide habitat for one-third of marine fishes; new species are cataloged annually even as the reefs reel from tourism and bleaching." (2000). As researchers, managers, activists and the general public seek to become more informed about coral reef resources, they often turn to NOAA through the Internet for their information needs. J.D. Bransford, in his book **How People Learn: Brain, Mind, Experience, and School** notes that "the meaning of "knowing" has shifted from being able to remember and repeat information to being able to find and use it." NOAA's Coral Reef Information System (CoRIS) was developed to serve as a single web portal for managers, researchers and the public and provide them with an online tool to find NOAA's coral reef data and information to use in managing, preserving and understanding coral reef ecosystems.

This document is designed to supplement the findings of the CoRIS Evaluation Workshop held on July 15, 2003 which have been summarized in the report **CoRIS Web Site User Evaluation Number 1: Findings and Recommendations** prepared by Sean Dennis of the Coastal Services Center. The main difference between the Evaluation Workshop and the coral community meetings is that the former focused primarily on the usability of the website (ease of navigation, problems accessing data, etc.) while the community meetings focused principally on the utility and potential of the site (types of data and information made available and how it is presented, etc.).

Coral Community Meetings—Background

A series of meetings organized by Mark McCaffrey, Science Communications Specialist with the NOAA National Climatic Data Center's Paleoclimatology Branch, were conducted between October 20th and 28th, 2003 with current or potential users of the NOAA Coral Reef Information System. The meetings were organized with the involvement of Sea Grant educators Sara Peck in Hawaii and Darren Okimoto in American Samoa, with the assistance of many others.

The meetings were held at a variety of locations including National Marine Sanctuary offices on the islands of Maui and Kauai, Windward and Maui Community College campuses, the NOAA Northwestern Hawaiian Islands Mokupäpapo Discovery Center in Hilo, the Convention Center in Pago Pago, American Samoa, and at the University of Hawaii's Hilo and Manoa campuses. Participants included directors of National Marine Sanctuaries, managers and researchers from NMFS, the National Park Service, the State of Hawaii, the University of Hawaii, the USGS, the American Samoan government and representatives from environmental organizations and the diving community. A listing of meeting locations, participants and evaluations of the meetings is included in the Appendices.

The community meetings were designed to meet with current and potential users of the Coral Reef Information System in order to accomplish the following goals:

1) Review the background of the CoRIS website,
2) Discuss its usability and utility,
3) Consider how to improve the website to meet the needs of local and regional coral communities,

4) Brainstorm how to make scientific data on coral reefs more accessible and meaningful to non-technical audiences, and
5) Develop dialogue and strategies for improving communication with key coral reef users, including but not limited to the CoRIS website.

An additional underlying goal was to identify potential data providers whose metadata could be added to the CoRIS catalogue.

Evaluation surveys of the meetings indicate that participants felt that these forums were successful at increasing awareness about CoRIS and providing a venue to dialogue with the coral community about the utility of the site and user needs. Many participants would have liked to have seen live demonstrations of the Data Discovery and other parts of the site requiring live Internet connectivity, but in most locations this was not possible. Participants strongly agreed that local island data and/or regional data collections be extremely helping in communicating coral reef science, but that data needed to be contextualized since most non-technical users are not data literate and often require raw data be interpreted and summarized. A summary of the evaluation surveys is included in Appendix C.

General Comments on CoRIS

While some of the suggestions made by participants in the meetings can be relatively easily implemented, other ideas are more ambitious and may be more difficult to incorporate into CoRIS. Nevertheless, such a "wish list" from those actively involved in coral reef issues does provide a vision for CoRIS developers of how, ideally, CoRIS can help meet the needs of its stakeholders. In particular, there was strong interest in providing specific and practical resources relating to what can be done to protect coral reef systems.

A number of common themes on how CoRIS can address the needs of various user communities emerged. In addition to the themes outlined below, several participants questioned whether CoRIS management would take the feedback seriously, whether there was a commitment from NOAA to continue to support the development of CoRIS, and whether there would be follow-up on the community meetings. Participants were assured that, so far as we know now, the answer to all these questions is "yes".

Several times participants suggested making the CoRIS homepage more dynamic, perhaps with a "What's New" section that could highlight the "top 10" new additions, offer profiles of scientists or particular coral regions, and provide updates on important news and time sensitive information for the coral community. For example, when the Living Reef program, developed with the state of Hawaii and numerous stakeholders through a Local Action Strategy process, is released, it could be prominently highlighted on the CoRIS homepage rather than being simply listed deep in the site as one of many coral reef programs. Users are interested in such time-sensitive information, particularly if their own efforts can receive such timely display.

Another general suggestion was for CoRIS to have "printer friendly" pages including the essays, NOAA reports and possibly journal articles available in PDF format or other easily printed format for easy download. It was felt these resources would be particularly helpful for teachers.

In both the workshop and community meetings, participants expressed a general sense that CoRIS will be a valuable tool for disseminating scientific data and information to researchers, educators, and the interested public about coral ecosystems and the forces that impact them. Background resources including essays, links to other web resources within and beyond NOAA, the glossary and bibliography were well received. Several participants commented on the daunting challenge CoRIS has taken on in providing access to global data and information relating to coral reefs, yet needing to also meet the needs of local coral communities.

In part because of NOAA's reputation and responsibility for monitoring and protecting coral and other ocean resources, there was a very high sense of expectation about what NOAA can and should deliver through CoRIS. In several meetings the feeling was expressed by some participants that CoRIS has yet to live up to its potential, particularly in terms of meeting the complex needs of local communities. One coral-savvy citizen expressed the opinion that the current CoRIS website "is strong on style but weak on substance." While perhaps some of the expectations may be impractical or beyond the scope of CoRIS' mission, they do provide a goal that we can strive towards.

At several meetings, participants asked for a CoRIS brochure or rack card that was geared more for a general user rather than a research scientist or coral reef professional. These could be distributed at various NOAA offices, county fairs, teacher fairs and other locations. The brochure might include a simple overview of the CoRIS data discovery tools, pointing to online tutorials that could help users walk through the steps to access and understand data and information resources for their area of interest.

Following are specific recommendations that have been synthesized and summarized from the input of the community meetings.

Addressing and Assessing User Group Needs

Who is CoRIS's primary audience? CoRIS' goals identify managers, researchers and the public as potential beneficiaries of the system, yet the needs of each group differ and should be revisited and perhaps redefined.

Research Community. There was general consensus that researchers often already have access to or knowledge of data in their areas of interest. While this is a somewhat surprising comment, several participating researchers agreed that they by and large know what research is being conducted in their areas of interest, and how to access and use this data. The data needs of researchers differ from most other users, and one area where they do need assistance is in helping them access data to conduct comparison studies to other regions or themes they are less familiar with. CoRIS can also serve as a convenient clearinghouse for raw data, perhaps with password-protected access in cases where the data is considered sensitive.

Advocates (Managers and Activists). One insight that emerged from the meetings was that managers and environmental activists have similar profiles in terms of the types of information they are seeking. While the groups are different in many respects, their information needs are overlapping. Neither group is as interested in raw data and as they are in products and summaries that interpret the data. Both seek socio-cultural, legal and policy information for their area of interest. At the same time, managers would

like to be able to communicate to researchers and other coral reef constituents the legal issues associated with coral reef protection and conservation. For example, many felt CoRIS maps should include all appropriate coverages of legal jurisdictions relating to coral reefs, including Marine Protected Areas, National Park Service and National Marine Sanctuary boundaries, as well as information on what these jurisdictions legally imply. One manager felt strongly that many researchers were neither aware of nor concerned with jurisdictional legal issues in locations they conducted their research in.

While there is a range of knowledge and skill levels for coral reef activists who are interested in learning about coral reef issues, there is also a range in the knowledge and skills of managers, particularly when they are involved with community-based and/or traditional approaches. With increasing awareness of the human impact on reefs through activities such as over-fishing and over-recreating, tools are needed that can help communicate conservation measures (including enforcement), promote awareness and help identify gaps would be appreciated by both managers and activists. Managers in particular are time-constrained, and don't have time to sort through raw data. Because they are the link between the researchers and public, specific products and services that assist their conservation efforts would be welcome by managers and other advocates for coral ecosystems.

For example, managers and activists would appreciate a source other than Google and potentially CoRIS, where they can find the latest research on topics such as the impact of gill net fishing on fish populations, or how MPAs can improve fisheries.

Education. Whether or not CoRIS should include an education section or a "CoRIS for Kids" section was a topic that there was interest but not full consensus on. Some felt that NOAA had a responsibility to promote environmental literacy and education, especially since these were now mission goals of the organization. The idea of developing supplemental materials such as tutorials tied to education standards or examples of student projects involving coral reefs were suggested. Others were concerned about "reinventing the wheel," noting that there are numerous excellent existing web resources that provide general information about coral ecosystems. There was agreement at many of the meetings that, while there are many general educational resources available about coral reefs, there is an existing and significant gap in detailed coral reef science materials. Thus, there is a compelling need for educational resources that make use of actual data and provide guidance from simple to complex coral reef science. Addressing this need is discussed in the section below on contextualizing data through a scaffolded approach.

Customized Interfaces. One approach to developing a more user-centric interface for CoRIS would be to configure and test user interfaces accessed through buttons or tabs that are designed to meet specific user needs:

- **Researchers** (password protected where necessary and managed with the involvement of local managers, providing access to raw data)
- **Advocates** (managers and activists, who, while different in many respects, may be looking for similar information such as summaries, graphs showing trends, etc.)
- **CoRIS in the Community** (for those interested in a specific place and all resources relating to it.)

- **CoRIS for Kids** (or **CoRIS in the Classroom**, offering PDF version of the Coral Reef coloring book, links to other coral reef resources for teachers and students and specific tutorials on coral reef science.)

One suggestion inspired by the **Professional Exchange** part of the CoRIS website was to provide access to list servers geared not only to researchers but to other regional or thematic user groups such as teachers or coral reef advocates in a particular area. Such list-serves would encourage communication and "cross pollination" within the community. Additional recommendations on how CoRIS might best address the needs of the education community are addressed below.

Contexualizing data through a "scaffolded" approach. The challenge of translating coral reef science and properly framing raw data was a theme discussed at virtually every meeting. The issue was described by one participant as the "end user problem"; if the user is not technically oriented yet wants to access data and information for their area of interest, it is important to make the data available in a format that doesn't take extra work on user's part to understand or access. Non-technical users will quickly become frustrated if the data are too complex, if there are too many steps to access the data or make sense of it, or if the files are too big.

With the aim of developing case-study examples and simple tutorials demonstrating the steps involved with accessing and understanding coral ecosystems related data, several regional and thematic areas have been identified as having strong potential for developing a layered approach to coral reef data and information. These themes include: i) the **Northwest Hawaiian Islands**, ii) the **Limahuli Ahupua'a** including coral reef on the island of Kauai'i, iii) an overview of **American Samoa's** coral resources including NPS and NMS, as well as village MPAs, and iv) **Sea Turtles**, perhaps with a focus on Kaloko-Honokohau NHP and the development around it. Specifics on each of these potential tutorial pilot projects are included below in the section **Next Steps**.

Randall Kosaki, who is the Research Coordinator with the Northwestern Hawaiian Islands Coral Reef Ecosystems Reserve, has been considering a five-tiered layered approach to framing the science research conducted in the Northwestern Hawaiian Islands which would dovetail with such an approach.

Developing such scaffolded materials is non-trivial, and tapping the talents of NOS's Ocean Explorer, Sea Grant educators as well as teachers and curriculum developers from the University of Hawaii and its community colleges and the Marine Option Program (MOP) would allow NOAA to build on existing curriculum and materials that convey coral reef science that could be customized around particular regions (such as the north coast of Kaua'i and the NWHI) and themes (alien species, sea turtles, etc.).

Library and About Coral Reefs Resources

Following are several themes that relate both to the background essays found in **About Coral Reefs** and the resources available through the **CoRIS Library**.

Focus on Alien Species in the Pacific. While the CoRIS website has background information on diseases and human and natural threats to reefs, there was some specific feedback from the Pacific coral community that the site needed to include background information on alien species, especially introduced seaweeds. The UH and

Bishop Museum have robust research and outreach efforts, some of it funded by NOAA, to help people become aware of and identify these species. Resources include A Guidebook of Introduced Marine Species in Hawaii by L.G. Eldredge and C.M. Smith, Bishop Museum Technical Report 21.

Inclusion of socio-cultural resources and research relating to coral reefs. The importance of including research on the human dimension of coral reefs was stressed, particularly by managers and planners who need such information for decision-support. Being sensitive to cultural and historical heritage also provides a way of "localizing" content to address the community context. It was suggested that in addition to annual reports from NOAA-funded coral programs, research from other agencies such as USGS and NPS should be sought since these agencies are generally more geared to the socio-economic research than NOAA. If possible, abstracts and data from peer reviewed journal articles should be added to the CoRIS catalogue.

Provide an overview of Marine Protected Areas, their benefits and related jurisdictional approaches to marine conservation. A theme discussed at several of the meetings related to how to more effectively communicate, particularly with the fishing community, the benefits of protecting reefs from overfishing. MPAs in particular are controversial, and fishing communities have become well organized and are quick to use "jobs versus the environment" messages to mobilize at a grass-roots level against agencies proposing MPAs and other jurisdictional protections. Being able to, for example, highlight scientific research on how MPAs can in the long run increase fish populations would be welcome, as would MPA boundaries on maps. Linking to the NOAA-hosted **Marine Protected Area Management Effectiveness Initiative** website would be appreciated by such users involved with MPA related issues: http://effectivempa.noaa.gov/welcome.html . Also see http://www.coralreefnetwork.com/mpa/hawaii_mpas.htm

On a related issue, there is anecdotal evidence to suggest that posters developed by NMFS and others showing the relationship between the size of mature fish and the number of offspring they can have if allowed to live to maturity are simple and effective tools to communicate the importance of protecting smaller fish. Web versions of such information would be helpful in communicating fish reproduction dynamics. Making formal research on MPAs accessible and pointing to resources such as ICRAN's **Effective Coral Reef Marine Protected Areas (MPAs): A solution for survival** (http://www.icran.org/pdf/MPA-sm.pdf) should also be considered.

Several participants also suggested adding to the bibliography (adding to the existing one and/or incorporating the one that Paul Jokiel at UH is developing) and making it easily searchable. An example of a searchable bibliography is found at http://bcn.boulder.co.us/basin/biblio/index.html

Networking with other Databases and Networks. Making databases, networks and other high-quality resources outside of NOAA easily discoverable and accessible through CoRIS was encouraged by many participants. This would require generating appropriate metadata for databases and resources, such as those developed by CRAMP, the Bishop Museum, and various coral reef NGOs. The American Samoan Department of Marine and Wildlife Resources (DMWR) has their own database of resources, but at this point it is not web-accessible and is only available on work stations at the DMWR headquarters or the public library.

Data Rescue. Several participants also mentioned the need to digitize numerous journals and data holdings that only exist in hard-copy format. In some cases, this may not be practical due to copyright issues. However, many reports from NOAA, other agencies and academic studies are available only in hard copy format. Given the need for substantial resources to undertake such a massive data rescue undertaking, several participants volunteered to take the lead in exploring this prospect with Senator Inouye's office. It should be noted that existing data rescue efforts in NOAA, such as the Climate Database Modernization Program, have been quite successful.

Data Discovery

The need to continue to increase the metadata resources of CoRIS is well-known to members of the CoRIS team. Since the original presentation for the meetings was prepared in early September, 2003, the number of metadata holdings in the CoRIS system has increased substantially. The director of one National Marine Sanctuary recommended that CoRIS also look to include a wide-range of general data and information that relate to coral regions already available through metadata in NOAA server rather than limit its scope to coral-specific resources. Such data and information could include information on National Marine Sanctuaries in the regions that have coral resources, weather, sea surface temperature, and surf forecasts. Examples of NOAA resources that are not yet included in CoRIS: Coastwatch http://coastwatch.nmfs.hawaii.edu/ and Tidesonline: http://tidesonline.nos.noaa.gov/

As an example of a NOAA product that is of interest to many of those active in the Hawaiian coral community is Pat Caldwell's Surf Forecast site through NWS. Unlike surfers who use this site to get a "heads up" on when and where the surf is up, divers, snorkelers and researchers conducting survey work use the site to know where the surf isn't high and therefore visibility is generally better. See: http://www.prh.noaa.gov/hnl/Products/SRF.php

Another example of a data of interest to coral advocates are data related to cruise ships and their impact. "There are activists and managers keeping track of cruise ships, but where is the data?" was a question posed at several meetings.

One participant in the Pago Pago meeting challenged CoRIS to take the lead in developing a "superlink" to data and information on American Samoan coral ecosystems, including its village approach to protecting coral reefs which was highlighted at the recent Coral Reef Task Force meeting. There was also strong interest in including terrestrial information, such as forestry, census data and coastal development because of their impact on coral ecosystems. The American Samoan Department of Commerce provided GIS data which Mark Monaco is reviewing to determine if these resources may be compatible with his mapping efforts.

Having an diverse array of web-resources accessible through CoRIS data discovery would be a plus according to several participants. One suggestion for improving the data discovery would be for a summary list of the types and quantity of data and information resources be provided which would offer an overview of the resources rather than a rather random complete listing. Because many if not most queries are place-specific, providing users with an integrated overview of resources available could enhance the user's ability to find exactly what they are looking for. Someone looking for an overview

of the island of Maui, for instance, might in this scenario conduct a text query that returns a list of the overall resources organized by data type that might look something like this:

Map Images (66)
- Boundaries/Jurisdictions (2)
- Aerial Photos (16)
- Bathy/Topo (23)
- Mosaic Photos (14)
- AVHRR (9)

Numeric Data (23)
- Sea Surface (9)
- Tide Data (4)
- Fish Census (10)
- Paleoclimatology (0)

Vector Datasets (10)
- Coral Mappings (6)
- Reef Locations (4)

Photography (37)
Documents (15)
News & Alerts (6)
Journal Articles & Reports (9)

Other Web Resources (4)
- NOAA (2)
- Non-NOAA (2)

Customized interfaces and search strategies for specific user groups could allow data discovery to be more effective for non-technical users.

In discussing metadata, one potential data provider asked “where is the metadata addition part of the website”? It was explained that currently CoRIS is focused first on NOAA data holdings, eventually moving to include metadata from other agencies involved with the Coral Reef Task Force. There was interest in including as many high-quality resources in CoRIS as possible, regardless of where they originate.

It was noted that while NOAA-funded coral reef work requires the data generated from the research will end up in CoRIS, there are currently no mandates that CoRIS metadata be generated for such data. Potential data providers were informed that CoRIS has support staff and web-forms that can support the generation of metadata with the aim of streamlining the process of creating metadata that can be indexed and searched through CoRIS.

Participants who had previously used the data-discovery tools expressed some frustration in the utility (not finding what they were interested in) and usability (not finding the tools easy to understand), especially of the GIS tool. This feedback echoed some of the concerns identified in the CoRIS Usability Workshop. These issues are currently being addressed by the CoRIS team.

Inclusion of a wide range of data including inventories conducted by non-PhD researchers. Many coral reef advocates have been involved with data collection using a variety of protocols. Some of the data has been used in formal research studies such as Dr. George Balazs' studies of tumors on sea turtles. Several such volunteers expressed the feeling that they didn't just collect the data for the fun of it, and if possible they would like to see their data being used, assuming it meets certain quality standards. Because the metadata will identify whether the data is, for example, peer-reviewed, gray literature or collected using particular protocols by volunteers or students, users should be able to determine for themselves whether they will want to use the data. There were some suggestions to allow easy recognition of the type and quality of data at a glance, possibly through the use of specific icons. Not everyone knows how to search through a metadata record for such information, and data discovery should be made as streamlined and easy as possible.

One participant who is a diving enthusiast volunteered to provide images of Hawaiian coral fish, which could be identified by their common names, their Latin names as well as their Hawaiian names. Such an illustrated inventory of fish could be a valuable education and research resource, but there currently is no mechanism to include such resources within the CoRIS system.

Protecting sensitive data. Several coral reef managers with the State of Hawaii expressed concern about making biologically sensitive information that could be misused too easily available to the general public. This included concern about potential exploitation and bio-piracy of reefs in parts of the world such as the Maldives where effective enforcement is lacking. A system for providing "gatekeeping" and controlling access to such sensitive data, such as password protection for researchers, may be appropriate, but such an approach needs to be carefully handled in order to maintain transparency and avoid alienating users. Ultimately, local agencies can serve as the gatekeeper and filter to sensitive data. Another potential solution to protecting sensitive data is to aggregate it at the level of an acre rather than provide exact location.

It should be noted that others disagreed with the need to be overly protective of data such as fish inventories, and some suggested that aquarium collectors already know the location of rare fish and are even more secretive than managers when it comes to protecting such information.

Connectivity Issues. Internet connectivity is of concern to many in the coral community, with the connectivity even in National Marine Sanctuary offices being limited to a dialup speeds, making spatial data discovery in particular an extremely slow process. Strategies to insure ease of use of the data discovery tools, perhaps through a client-side rather than server-side interfact, would be appreciated by those in coral communities who lack fast Internet connections.

Next Steps

Following are potential pilot projects that could, with sufficient funding and technical support, provide CoRIS with case-study examples of place-based or thematic science research relating to coral ecosystems.

Highlight the terrestrial and marine aspects of coral reef ecosystems in American Samoa. While CoRIS may not ultimately be the appropriate site for a "superlink" to

American Samoa, The Governor's Coral Reef Advisory Group and Coral Reef Initiative-American Samoa coordinated by Christopher Hawkins (amsamoacrag@yahoo.com) is eager to work with CoRIS to highlight some of the diverse efforts to research and protect coral resources (including their village programs to protect reefs). Three-CDs of GIS data have been provided to Mark Monaco in order to determine whether they may be compatible with NOS mapping efforts. Troy Curry, GIS Planner with American Samoa's Coastal Management Program, was interested in whether the CoRIS metadata webforms developed using Blue Angel might help in their metadata generation efforts. They are also interested in having their GIS resources mirrored from the mainland since connectivity in American Samoa is somewhat limited. Contact:

Troy Curry
GIS Planner
American Samoa's Coastal Management Program
Department of Commerce
Executive Office Building
Pago Pago, AS 96799
Phone: 684-633-5155
Email: tcurry@doc.asg.as

USGS Metadata Experiment. Because DOI, including the USGS, is a partner in the Coral Reef Task Force and is engaged in coral reef research and related education and outreach efforts, there is an opportunity to test the viability of including USGS metadata (which meets FGDC/NBII standards) in the CoRIS system. Several representatives of USGS participated in the CoRIS community meetings including Mark Fornwall, Director of the Center for Biological Informatics and Node Coordinator of the Pacific Basin Information Node (PBIN), and William Steiner, Director of the Pacific Island Ecosystems Research Center. Both expressed an interest in exploring collaboration with CoRIS beginning with an experiment that could determine the compatibility of metadata from USGS's coral reef research in the region. This could demonstrate the potential for CoRIS to serve as a clearinghouse for metadata and resources of other agencies involved with the Coral Reef Task Force. USGS researcher Mike Field has also agreed in principal to make metadata on his research on tracking coral larvae on Maui and Molokai available.

See: Pacific Basin Information Node (PBIN): http://pbin.nbii.gov/
http://coralreefs.wr.usgs.gov/
http://walrus.wr.usgs.gov/infobank/
http://walrus.wr.usgs.gov/infobank/programs/html/main/activities.html
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Holding a meeting with NOAA, USGS and potentially NPS representatives could serve as a forum to scope out such an interagency collaboration in support of Coral Reef Task Force and related goals.

Develop Case Study on the Socio-Cultural Aspects and Coastal Development Impacting Coral Reefs on West Hawaii. The importance of framing issues relating to coral reefs in their complex social, economic and cultural context was stressed by many participants. The Kaloko-Honokohau National Historical Park near Kona and Marine Protected Areas on the Big Island provide an opportunity to leverage existing work and highlight the work of the National Park Service and other stakeholders. In addition to the historical and cultural background of the region, coastal development around the Park, including golf courses, porous soils, and possible harbor expansion for cruise liners at the south end of the park make this area an example of the multi-dimensional issues relating to coral reef conservation: See: http://www.nps.gov/kaho/index.htm .
He Wahi Mo'olelo 'ohana No Kaloko Me Honokohau Ma Kekaha O Na Kona
A Collection of Family Traditions Describing – Customs, Practices and Beliefs of the Families and Lands of Kaloko and Honokohau, North Kona, Island of Hawaii
http://www.nps.gov/kaho/home/oralhistory/index.htm

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Highlight North Coast of Kauai. The Garden Island of Kauai and specifically the watersheds draining the north coast provides an opportunity to link together a variety of diverse programs and research efforts. These could include information about the following:

- Provide an overview of the concept of Ahupua`a, the traditional management and self-reliant watershed community including coral reefs:
  http://www.hawaiian.net/~cbokauai/ahupuaa.html
  http://www.k12.hi.us/~ahupuaa/
  http://www.hawaii.edu/environment/ainakumuwai/html/ainakumuwaiahupuaacontents.htm

- Focus on the Limahuli National Tropical Botanic Garden and reef monitoring efforts funded by The Nature Conservancy's Marine Conservation Program:
  http://ntbg.org/limahuli.html

http://www.hawaiicommunityfoundation.org/doc_bin/publications/Marine_assessment.pdf

- Efforts funded by fisheries to remove alien species from the Limahuli watershed: http://www.plant-talk.org/Pages/32limah.html

- USGS studies on the impact of sediment on reefs in the region: http://www.hanaleiriver.org/science/contaminants.htm

- The Hanalei Heritage River http://www.hanaleiriver.org/

The materials could be enhanced with the NOAA Biogeography Program benthic maps which are available through CoRIS but more directly accessible from the NOS website. http://sag1.nos.noaa.gov/Website/HI_Kauai/viewer.htm

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Other watershed resources that can provide insight into terrestrial impacts on coral systems include the Kailua Bay Advisory Council (KBAC) on the island of Oahu which was funded by a lawsuit against the city and county of Honolulu for non-point source pollution:
http://www.kbac-hi.org/ . In particular note the ahupua`a mapper:
http://www.geocortex.net/mapping/kailua/map.htm

A simple tutorial building on existing CoRIS resources of the region and linking to the above mentioned supplemental materials could provide an initial framework that can be further developed by meeting with key stakeholders.

Develop Scaffolded Educational Materials Focused on the Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve. Building on the excellent educational materials about the NWHI developed by Ocean Explorer and developing "layered" lesson plans that utilize the process of scientific inquiry to frame the scientific data in a multi-disciplinary context would be of significant benefit to science educators and others interested in coral reef science. A CoRIS CD-ROM and/or DVD that includes multi-media materials such as slideshow and music on the Northwestern Hawaiian Islands (if available) could provide an interdisciplinary dimension to the effort. This could also be an opportunity to collaborate with USGS and the University of Hawaii who have also been extremely involved with research in the NWHI and in environmental education. See:
http://hawaiireef.noaa.gov
http://oceanexplorer.noaa.gov/explorations/02hawaii/background/education/education.html
http://atsea.nmfs.hawaii.edu/

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Develop a CD-ROM and/or DVD Product. In part because of connectivity issues, having an alternative version of CoRIS and related NOAA coral resources on a CD-ROM and/or DVD could potentially reach audiences that can't or won't access the CoRIS website. Ideally such a product could include multimedia materials (digital video, slideshows, music, etc.) and tutorials that make use of data/information on the CD/DVD. The fact that Tom Lapointe's group in NOS has already been developing something along these lines bodes well for such an effort. It should be noted that the National Wildlife Federation has just finished a DVD on corals and climate that was funded by a NOAA grant. Contact Patty Glick to obtain a copy: glick@nwf.org

Highlight Sea Turtles. Many people involved with or learning about coral ecosystems become fascinated by sea turtles. NMFS zoologist George Balazs has studied them for years, both in terms of their health and their migrations. Many of his studies have been made available in various proceedings and NOAA technical memos, but much of the formal research isn't easily available online at this point. See:
http://www.nmfs.noaa.gov/prot_res/PR3/Turtles/turtles.html

Add Additional Images. While the NOAA Photo Library has some excellent images and CoRIS accesses aerial photographs for many coral regions, a photo gallery and inventory of Hawaiian coral fish including common, Latin and Hawaiian names would be a powerful and popular resource. See existing fish photos on the Hawaii Coral Reef Network:
http://www.coralreefnetwork.com/marlife/fishes/fishes.htm

Add Section on Preventing Reef Damage. Several participants suggested having simple materials that could help coral reef advocates be proactive in preventing reef damage. While NOAA does have some materials on such issues, they are generally not geared for a general audience. Serving as a clearinghouse for materials geared for different audiences (such as "Don't Stand on the Coral" for snorkel/dive operators) would be appreciated by many advocates. See:
http://www.csc.noaa.gov/techniques/vessel_groundings.html

Summary
Following are key recommendations that were emerged from the meetings held with the American Samoan and Hawaiian coral communities.

- Make the CoRIS homepage more dynamic, highlighting current news, new data, etc.
- Consider specific user interfaces, particularly for data discovery where a “one size fits all” doesn’t necessarily work for non-technical users.
- Whenever possible, provide summarized information and understandable visualizations rather than raw data, which many users don’t have the skills or the time to translate or analyze on their own.
- Develop new essays and related library links to information relating to “Protecting Coral Reefs,” “Alien Species,” and “Sea Turtles.”
- Consider developing a searchable bibliography, and explore combining efforts with Paul Jokiel.
- Provide when possible data discovery of diverse and integrated resources including terrestrial impacts, journal articles and other databases and “place-based” resources.

Specific near-term opportunities include developing “scaffolded” materials on the Northwest Hawaiian Islands, Limahuli Ahupua'a, Sea Turtles and American Samoa.

References

Bransford, J. D., et. al. 2000. How People Learn: Brain, Mind, Experience, and School. National Academy Press. 5.

National Research Council. 2003. Exploration of the Seas: Voyage Into the Unknown. 4.

APPENDIX A

CoRIS Data Outreach Community Meetings

October 20, Mon. --Convention Center, Pago Pago, American Samoa, 9:00am to 11:00am.

October 21, Tues. --Windward Community College, Oahu, Hale ‘Imiola conference room 121, 12:30 to 2:30pm.

October 22, Wed. --National Marine Sanctuary Coordinating Office, Kukui Executive Center, Lihue, Kauai, 9 to 11am.

October 23, Thurs. --UH Hilo, Campus Center #306-7, 12:30 to 2:00pm and Northwest Hawaiian Islands Visitor Center, 4:30 to 6:30pm.

October 24, Fri. --Kaloko Honokohau National Park Headquarters in Kaloko Industrial Park, 8:30 to 10:30am.

October 25, Sat. --Humpback Whale Sanctuary Education Training Center, Kihei, Maui, 3 to 5pm.

October 27, Mon. --Maui Community College, Ag. 101, the Marine Option Program room, 10 am-12 noon.

October 28, Tues. --DLNR building on Punchbowl St. 10am to 12 noon.

October 28, Wed. --UH Manoa Campus Center, room CC309, 8am-12 noon.
Informal meetings were also held at Limahuli National Tropical Botanical Garden, the Waikiki Aquarium, the National Park Service in Pago Pago, and the Hanauma Bay Nature Preserve.

APPENDIX B

Participants of the various CoRIS Coral Community Meetings representing the research, resource management, education and outreach, planning and activist communities include:

Greta Aeby
Kaliko Amona
Fernando Lopez Arbarello
Jennifer Bach
Sallie Beavers
Leomi L. Bergknut
Donna Brown
Bob Bruck
Athline Clark
Ann Coopersmith
Emmanuel Coutures
Troy Curry
Rhyn Davies
Marta deMainte
Stuart Donachie
Ann Fielding
Liz Foote
Mark Fornwall
Alana Goo
Dave Gulko
Skippy Hau
Chris Hawkins
Mark Heckman
Alan C. Hong
Bob Jacobson
Steve Kolinski
Randall Kosaki
Dave Krupp
Elizabeth Kumabe
Jeffrey Kuwabara
Matt Lei
Steve Lundblad
Josie Malepeai
Lisa Marrack
Sherwood Maynard
Mike Misa
Paul Murakawa
Robin Newbold
Zoe Norcross
Mia Nykollik
Darren Okimoto
Mike Parsons
Sara Peck
Maryjane Porter
John Pye
Patricia Richardson
Sasauli Satele
Fatima Sauafea Rachel Shackelford
Jean Nishida Sousa
Mark Speck
Bill Steiner
Emmanuel Tardy
Rosia Tarita
Christianeva Tiutele
Soli Tuaumu
Tali Tuinei
Malelega Tulolosega
Makeati Utufiti
Deborah Vaoalii
Maria Vauga
Judith Vergun
Dean Watase
Lisa Wedding

APPENDIX C

Summary of NOAA Coral Reef Information System
CoRIS Community Meetings Evaluation

The following summarizes the responses from 29 participants who completed a post meeting evaluation form

How would you rate your knowledge of what CoRIS currently provides where 1= no knowledge of CoRIS, 5= very knowledgeable

Before the meeting	1	2	3	4	5
Total	**14**	**10**	**5**	**-**	**-**

After the meeting	1	2	3	4	5
Total	**-**	**1**	**8**	**13**	**7**

What are some specific ways you could currently use CoRIS in your work?
Most of the comments related to the importance of being able to access data and information relating to local coral ecosystems and issues.

What changes would make CoRIS more useful to you in your work?
The responses included offering a library of PDF versions of journal articles, fact sheets, past research; including information on MPAs, coastal land development and watersheds; more education materials; keep it simple!

How useful would local island data and/or regional data collections be to your efforts to communicate coral reef science. (1= not useful, 5= very useful) Please elaborate.

	1	2	3	4	5
TOTAL	**-**	**2**	**2**	**5**	**20**

While local data was almost universally regarded as a plus, one comment suggested that without translation to contextualize the data, it wouldn't be useful.

What resources could CoRIS provide that would be useful to you when working with audiences who do not have access to the Internet?
Suggestions included workshops, booklets, videos and CDs, posters and maps.

What was most effective about this meeting?
Brainstorming; discussion; overview of CoRIS

What would have improved this meeting?
Live, fast internet connection (mentioned five times); smaller room; more people; better coordination with local agencies; a little tighter initial presentation.

The majority of participants left contact information for follow-up.

APPENDIX D
Resolution on Improving Outreach Approved during August 2003 Coral Reef Task Force Meeting

Resolution 4. Proposal on Improving Outreach by and participation in the CRTF
Public participation plays an important role in the activities of the United States Coral Reef Task Force. Public awareness of and involvement in coral reef protection and preservation is vital to the long-term survival of coral reefs.
Many organizations and individuals have expressed a strong continuing interest in assisting the Task Force in achieving the goal of coral reef protection and preservation, and maintaining this interest and desire to support the Task Force's efforts will be crucial to coral reef protection and conservation.

Members of the public and organizations that have a special interest in coral reefs are also a valuable source of information about reef health and protection.
The Task Force has actively sought out such information by, for example, hosting panels to present information on a wide variety of coral reef-related topics at Task Force meetings and by establishing a tradition of an open public comment session at each Task Force meeting.

The non-Federal Task Force member States and Territories have also actively sought out and encouraged public participation and involvement at their respective local levels.

In response to the Task Force's charge, the Steering Committee, together with the Outreach and Education Working Group, have also explored further options and proposals for improving public outreach, involvement and participation in the Task Force's work.

As part of its exploration, the Steering Committee received valuable input from members of the public and the All-Islands Committee.

As a result of this exploration and collaboration, the Steering Committee developed several ideas for improving outreach and participation, some of which are already being implemented as part of the October 2003 Task Force meeting.
Other ideas will require a more extensive commitment of time and resources from Task Force members.

Now therefore the Task Force directs that the following specific actions be taken:

1. Improve Outreach Via the Coral Reef Task Force Web Site. The Steering Committee will ensure that the Task Force web site provides members of the public with information about the full range of the Task Force's activities, opportunities for public participation and input, and information about coral reef protection and preservation more generally. The Steering Committee will report on progress toward this task at the February 2004 Task Force Meeting.
2. Responding Task Force Meeting Public Comments. The Steering Committee will establish a mechanism for responding to the concerns raised in the public comment session at each Task Force meeting, preferably utilizing currently available mechanisms where feasible, and reporting back to the public on such responses. The Steering Committee will report on this mechanism at the February 2004 Task Force meeting.

3. Local, Scientific and National Policy Issues at Task Force Meetings. Future Task Force meetings will ensure that there are opportunities in addition to the public comment session for increasing information exchanges between the Task Force and the scientific and local communities. Such a forum might include, but is not limited to, a presentation discussing (a) local concerns and approaches to coral reef-related issues at Task Force meetings held outside of Washington, and (b) scientific and/or national policy issues at Task Force meetings held in Washington.

APPENDIX E

Goals of NOAA Coral Reef Information System (CoRIS)

- Improved management and preservation of coral reefs.
- Through a single web portal, managers, researchers and the public will have centralized access to NOAA's coral reef data and information for the purposes of managing and preserving coral reefs.
- Encourage contribution of data and metadata by NOAA and non-NOAA coastal data holders.

Purpose of the U.S. Coral Reef Task Force

The United States is one of many nations around the world working to halt the coral reef crisis and protect, restore and sustainably use coral reef ecosystems for current and future generations.

The U.S. Coral Reef Task Force (CRTF) was established in June 1998 through Executive Order #13089 on Coral Reef Protection to lead the U.S. response to this growing, global environmental crisis. The CRTF is responsible for overseeing implementation of the Executive Order, and developing and implementing coordinated efforts to:

- map and monitor U.S. coral reefs;
- research the causes and solutions to coral reef degradation;
- reduce and mitigate coral reef degradation from pollution, over fishing and other causes;
- implement strategies to promote conservation and sustainable use of coral reefs internationally.